

The sixth and seventh sections contain instructions for mineral analysis, and one is struck by the very complete account given of methods by which the decomposition of the mineral is effected by heating in a current of gas, e.g. oxygen, hydrochloric acid, or bromine. The eighth section is taken up with silicate analysis, whilst the concluding section gives an account of the estimation and separation of the halogens and of many other analyses which do not naturally find a place in the earlier portions of the work.

Although it is clear that the author has taken great pains in the preparation of his book, it may be questioned as to whether the selection of exercises has been uniformly judicious, and as to whether the author's own processes do not occupy a too prominent position, so leading to the exclusion of standard methods of analysis with which every student should be familiar. For example, the author's process for the separation of manganese and zinc by means of hydrogen peroxide in alkaline solution, although found unsatisfactory by other investigators, is fully described to the practical exclusion of the more usual method. The same criticism applies to the larger proportion of the other "hydrogen peroxide separations" which here figure so largely. Again, in the section dealing with silicate analysis, the author's methods of decomposition, especially the one employing boric anhydride, are given at great length, whilst the ordinary method of alkali-carbonate fusion, which is constantly employed both in technical and scientific analyses, is given in a not very happily modified form, and in a subordinate position.

Although the book presents very many excellent features, and should, when used in conjunction with other works, be of great value, it is hardly considered likely that a student who derives his information solely from this source would possess a competent knowledge of the general methods of analytical chemistry.

H. D. D.

Practical Slide Making. By G. T. Harris, F.R.P.S. Pp. 134. (London: Iliffe and Sons, Ltd., 1904.) Price 1s. net.

NEARLY every photographer at some time or another makes his own lantern slides, and so numerous are the methods available, and so varied are the results that can be obtained, that another handbook on the subject is very welcome. In these pages the author successfully attempts to supply trustworthy information on the subject in a concise form, describing the best known methods for obtaining these transparencies. He lays stress on the great efficiency of some of the older processes, and with the hope that they may be revived he includes them in this book. The first two chapters deal with the apparatus for exposing the plate, and the remainder treat of the development by the several methods described, and of the various other manipulations required before the slide can be considered properly finished. No pains seem to have been spared to obtain accuracy in the formulæ and to render clear the methods of procedure, so that the book forms a trustworthy guide.

Botany Rambles. Part ii. *In the Summer.* By Ella Thomson. Pp. 130. (London: Horace Marshall and Son, 1904.) Price 1s.

THE young learners for whom this little book is intended are urged persistently to see for themselves, by examining plants, that what is told them in the lessons is true. They are instructed in simple language how to set about this work of verification and are urged to make use of their own eyes to find out additional facts for themselves. It is evident that the writer understands children and knows how to arrest their interested attention.

NO. 1810, VOL. 70]

LETTERS TO THE EDITOR.

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The Exradio Spectrum.

FROM a private communication from Mr. Baxendall, I learn that he has noticed the following correspondences between the spectrum of the emanation from radium (exradio) and the spectra of "bright line stars" (Campbell, *Ast. and Ast. Phys.*, vol. xiii. p. 468):—

"Exradio."	Bright Line Stars (Campbell).
5805	5813
5595	5593*
4690	4688
4650	4652
4630	4633

With the exception of 5593*, these stellar lines are all strong and characteristic. Another of the exradio lines, 5137, may correspond with 5135.

I am very ignorant of stellar spectra, and send this note merely to direct attention to a possible correspondence.

University College.

WILLIAM RAMSAY.

The Occurrence of Radium with Uranium.

A LITTLE time back, Mr. B. B. Boltwood published in this Journal (May 26, p. 80) a preliminary notice of an investigation of the ratio of uranium to radium in various minerals. I have for some time been engaged in a similar investigation, which, though the results are not yet matured, seems to be leading to the conclusion that this ratio is constant, as in Mr. Boltwood's experiments. An interesting case is the mineral torbernite, or copper uranite. This mineral forms transparent green tetragonal crystals the composition of which is accurately represented by the formula $\text{CuO} \cdot 2\text{UO}_3 \cdot \text{P}_2\text{O}_5 \cdot 8\text{H}_2\text{O}$. The substance dissolves easily in sulphuric acid, forming a perfectly clear green solution. This solution, when boiled, gives the radium emanation, and the quantity of emanation produced in one day is about the same as that yielded by the same weight of Joachimsthal pitchblende. The percentage of uranium is also about the same. If the radium in this mineral has been produced since the formation of the mineral (and the recent quantitative experiments of Sir W. Ramsay and Mr. Soddy on the absolute rate of production of the emanation seem to make that certain), there is practically no choice as to what the parent substance should be. Uranium is the only candidate. The great complexity of most of the radio-active minerals may make it difficult to obtain conclusive evidence by studying them. But here there seems to be no alternative but to conclude that uranium is the parent.

R. J. STRUTT.

Residual Affinity.

SIR OLIVER LODGE'S highly suggestive letter (June 23, p. 176) will be welcome to the many chemists who have been endeavouring to interpret chemical phenomena in terms of the electronic theory of the physicist. The proposition that the "Faraday tube" may be subdivided would appear to be capable of being widely applied in connection with many of the most interesting phenomena of chemistry. Thus not only would the existence of water of crystallisation and the formation of so-called molecular compounds be thereby brought into line with the more typical manifestations of valency, as pointed out in Sir Oliver's letter, but it would appear that it may possibly enable the hitherto conflicting hydrate and dissociation theories of solution to be harmonised. Thus in the case of an electrolyte such as sodium chloride, we should in the dry state regard the sodium atom united to the chlorine atom by means of a Faraday tube or bundle, as it may more appropriately be designated, the union leading to the great stability of the compound as such. On the addition of water, however, some of the constituent fibres or strands of the bundle become deflected in such a way that the sodium

and chlorine atoms become respectively combined with water. With sufficient water present the original union between the sodium and chlorine atoms will become entirely severed, the Faraday bundle starting with its positive extremity on the sodium atom will terminate at its negative end by means of a plurality of strands on a number of water molecules, and similarly the Faraday bundle emanating by its negative extremity from the chlorine atom will terminate at its positive end in a plurality of strands also on a number of water molecules. In such a solution we should thus have independence of the sodium and chlorine atoms, or the phenomenon of ionisation. In such a solution, moreover, the union between sodium and chlorine would be entirely abolished through the complete diversion of the strands of the Faraday bundle formerly uniting them, whilst the union between the oxygen and hydrogen of the water molecules would be but slightly weakened owing to only a small fraction of the total number of strands in the bundles uniting the oxygen and hydrogen in each molecule being diverted by the sodium and the chlorine. The dissociation into its ions of an electrolyte on solution in water would thus be the consequence of the antecedent hydration of the ions.

Some of the colour changes attending the attachment of water of crystallisation may be interpreted in the same way. Thus anhydrous copper sulphate is colourless, whilst the crystallised salt containing five molecules of water is blue. The direct union of the copper atom by means of two Faraday bundles with the SO_4 -group leads to the production of a colourless compound, whilst by the diversion of the strands of these bundles, through the attachment of five molecules of water, the copper atom and the SO_4 -group become severed, and the blue colour characteristic of the copper ion makes its appearance.

According to this view solution should always be attended by the weakening of the union between at least one pair of bonds in the molecule of the solute owing to the diversion of at any rate some strands of the bundle or bundles, and such loosening is betrayed in the greater chemical reactivity of substances in solution.

Similarly in catalytic phenomena, the catalytic agent may be regarded as diverting some of the constituent strands of bundles, and the action of water in effecting ionisation, i.e. complete diversion of bundles, would thus appear as an extreme case of catalysis, leading to such an acceleration of the velocity of reaction between electrolytes that reactions between ionised electrolytes are practically instantaneous.

It is needless to say that this is merely a preliminary and very imperfect attempt to apply the electronic theory to a few of the most familiar and important chemical phenomena. Sir Oliver Lodge's suggestion with regard to the electrical interpretation of valency and bonds is indeed so luminous and stimulating that it should provoke the careful review of chemical facts by the light of this new conception of the possibility of an indefinite number of different grades of chemical union, of which the union by chemical bond, hitherto the only one generally recognised, is to be regarded merely as an extreme case.

Birmingham, June 27.

PERCY F. FRANKLAND.

Science in the Common Examination for Entrance to Public Schools.

In the interests of education, may I ask you to find room in your columns for the enclosed copy of the science paper recently set in the above examination? The average age of the candidates may be taken as about thirteen years. Comment is almost superfluous. The effect, whether intentional or not on the part of those who set the questions, of such an examination paper must be to discourage science in the preparatory schools. No boy of thirteen years of age could or should be expected to answer more than a very small portion of so advanced a paper. If headmasters of preparatory schools are led to imagine that this is the kind of thing that is expected of their pupils, in very despair they will be forced to abandon science entirely, and fall back upon its alternative in this examination—Latin verse.

This common examination has now been held for the first time, and it is important that an emphatic protest

should be raised without delay. If the science paper is allowed to be of this unreasonable character, the subject will receive a set-back that will go far towards undoing all that has been tardily achieved during the last twenty years in regard to scientific teaching in our public schools.

OSWALD H. LATTER.

Charterhouse, Godalming, July 2.

June 29, 1904.—SEVENTH PAPER.

(Alternative with Latin Versè.)

COMMON EXAMINATION FOR ENTRANCE TO PUBLIC SCHOOLS.

SCIENCE.—(One hour.)

I.—Physics.

(1) A weight hangs by two strings each making an angle of 60° with the vertical. Show that the tension of each string is equal to the weight.

(2) A uniform rod 10 feet long and weighing 5 lb. is pivoted 3 feet from one end. A weight of 50 lb. is hung on the end nearer to the pivot. Find what weight must be hung on the opposite end to balance the rod.

(3) Gravity is often measured by the number 32. Explain this. A body is thrown up with a velocity of 48 f. s. In what time will it lose its velocity? In what time will it return to the hand? How high will it go?

(4) A rectangular vessel on a square base is filled with water. Find the relation between the height of the vessel and a side of the base in order that the fluid pressure on one vertical face may equal that on the base.

II.—Botany.

(1) Enumerate the floral whorls from outside inwards. Explain what is meant by cohesion and adhesion among floral organs. Make a careful drawing of the section through a flower in which petals and stamens adhere to the calyx tube. Name a flower in which you have observed this structure.

(2) A potato is often spoken of as a root. Is this correct? Give reasons. Name three other cases in which a similar error is made, explaining the real nature of the organ in question.

(3) Draw sections shown in cutting lengthwise through a bean (or acorn) and a grain of barley (or date stone). What difference would be observed during their early growth? Of what great divisions of plants are these characteristic respectively?

(4) What plants would you expect to find in flower in a damp wood on a clay soil in April? Describe one or more of them.

An Early Mercury Pump.

It may interest some of your readers to know that as early as 1820 an air pump was described depending on the formation of a Torricellian vacuum, and therefore on the same principle as Geissler's and its successors. The paper is by M. Fafchamps—"Description d'une machine pneumatique à l'aide de laquelle on opère le vide sans le secours de la pompe" (*Annales générales des Sciences physiques*, Bruxelles, vol. vi., 1820, pp. 101-2).

A vertical tube standing in a trough is provided with a stop-cock near its upper end. The tube above the stop-cock has a reservoir at the top, and on each side is a stop-cock, one connected with the vessel to be exhausted and the other to a large funnel. The upper end of the reservoir is also provided with a stop-cock. To work the machine the reservoir is first filled with mercury or some other liquid which is introduced through the funnel, the air being expelled through the stop-cock at the top of the reservoir. When filled with liquid the stop-cock of the reservoir is closed, and communication with the funnel is cut off. The stop-cock on the tube is now opened, when a Torricellian vacuum is produced in the reservoir; on opening the cock connected with the receiver air is withdrawn, and so on.

The author remarks that if mercury is used, the vertical tube must be 758 mm. long; if water, the tube must be more than 10 metres, but the length of the tube may be reduced by diminishing the atmospheric pressure on the